National Ignition Facility & Photon Science

The National Ignition Facility at a Glance

The National Ignition Facility (NIF) is the world's largest laser system, housed in a ten-story building the size of three football fields at Lawrence Livermore National Laboratory east of San Francisco.

NIF's 192 laser beams are capable of delivering at least 60 times more energy than any previous laser system. When ignition experiments begin in 2010, NIF will focus up to 1.8 million joules of ultraviolet laser energy on a tiny target in the center of its ten-meter-diameter target chamber – creating conditions similar to those that exist only in the cores of stars and giant planets and inside nuclear weapons. The resulting fusion reaction will release many times more energy than the laser energy required to initiate the reaction.

Experiments conducted on NIF will make significant contributions to national and global security, could lead to practical fusion energy, and will help the nation maintain its leadership in basic science and technology. The project is a national collaboration among government, industry and academia and many industrial partners throughout the nation.

NIF Control Room

NIF's complex operation, alignment and diagnostic functions are controlled and orchestrated by the integrated computer control system. It consists of 300 front-end processors attached to nearly 60,000 control points, including mirrors, lenses, motors, sensors, cameras, amplifiers, capacitors and diagnostic instruments. The shot director (left) must coordinate all 14 NIF subsystems when preparing for a shot.

National Ignition Facility on the Web:
https://lasers.llnl.gov

NIF AT A GLANCE

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NIF's Missions

- Support the U.S. National Nuclear Security Administration's Stockpile Stewardship Program, which ensures a safe, secure and reliable nuclear stockpile, by conducting experiments to enhance understanding of the physics of nuclear weapons.
- Demonstrate the feasibility of inertial confinement fusion as a clean source of energy.
- Enable advances in fundamental high energy density science that will aid in understanding the basic physical processes that drive the cosmos.

NIF Timeline

January 1993	NIF's conceptual design study approved
May 1997	NIF groundbreaking ceremony
June 1999	Target chamber dedicated
December 2002	First tests of four laser beams generate 43 kilojoules of infrared light in a pulse lasting five billionths of a second
May 2003	NIF produces 10.4 kilojoules (kJ) of ultraviolet light in a single laser beam, setting a world record for laser performance
July 2007	First laser bay is completed and commissioned
October 2008	Second laser bay is completed and commissioned
December 2008	All 192 target chamber final optics installed
January 2009	All line replaceable units installed; all project performance completion criteria met, including 96-beam pulse energy of 540 kilojoules (500 kJ required) and 207 terawatts of peak power (200 TW required)
March 2009	1.1 megajoules of ultraviolet energy fired to target chamber center
March 2009	Formal certification of NIF project completion by National Nuclear Security Agency
Summer 2009	192-beam experimental shots to target chamber center begin
2010	Ignition experiments begin

NIF by the Numbers

Total laser energy	4.2 million joules (infrared)
Energy on target	1.8 million joules (ultraviolet)
Equivalent peak power	500 trillion watts (20-nanosecond shaped laser pulse)
Large (meter-scale) optics	7,500
Small optics	More than 26,000
Computer control points	60,000
Target chamber diameter	10 meters
Target chamber weight	130 metric tons
Target diameter	~2 millimeters
Target temperature at ignition	>100 million degrees Centigrade
Target pressure at ignition	>100 billion atmospheres
Neutrons made during ignition	100 septillion (10^{26}) per cubic centimeter

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